

# Research on the Impact of Financial Development on Technological Innovation in Labor-intensive Industries: Based on Two-way Fixed Effects Model

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**Abstract.** Based on the current reality that China's factor endowment and comparative advantage should develop labor-intensive industries and the country's strategic requirement of building an innovative country, matching financial development with the technological innovation requirements of labor-intensive industries is both an objective requirement of China's national conditions and a theoretical requirement of the great reality of building an innovative country. To study the impact of financial development on labor-intensive industry innovation, this paper is based on the panel data of 30 provinces in China from 2011 to 2020, the paper applies the two-way fixed effects model, this paper empirically tests the influence of financial development on technological innovation in labor-intensive industries. The results show that the financial correlation ratio has an inverted U-shaped influence on the technological innovation of labor-intensive industries, the development of digital finance has a significant positive promoting effect on the technological innovation of labor-intensive industries, indirect financing is more conducive to the technological innovation of labor-intensive industries, and the concentration of banks is not conducive to the technological innovation of labor-intensive industries.

**Keywords:** financial development; labor-intensive industries; technological innovation; fixed effects model

## 1 Introduction

The 20th Party Congress proposed to accelerate the implementation of the innovation-driven development strategy, and financial development is the key to determining whether China's innovation-driven development strategy can be successfully realised. China's labor-intensive industries have a complete manufacturing system of industrial chains, industrial clusters with strong agglomeration effects and good manufacturing and technological capabilities, and are still highly competitive in the international market. The current international situation is becoming increasingly serious and complex, especially the continued spread of the Newcastle pneumonia epidemic outside China, which has added uncertainty and instability to global economic development. In this context, the development of labor-intensive industries in China is an inevitable choice to cope with the impact of the epidemic in the short term, and is also determined by the realities of the largest developing country in the long term. Matching financial development with the technological innovation requirements of labor-intensive industries is both an objective requirement of China's national conditions and a theoretical requirement of the great reality of building an innovative country.

## **2 Literature review**

### **2.1 Research on technological innovation in labor-intensive industries**

Differences in the nature of industries, particularly in factor intensity, can lead to differences in the extent to which firms rely on technological innovation (Arrow, 1962), with differential effects on technological innovation inputs and outputs. Acemoglu (2003) finds that an increase in skilled labor (unskilled labor) leads to technological progress that is skewed towards skill-intensive (labor-intensive). Xie and Zhang (2015) and Wei et al. (2017) argue that rising labor costs significantly boost innovation in labor-intensive firms. Zhang Tengfei and Yang Jun (2016) [1] point out that the government should fully consider the comparative advantage of production factors when formulating industrial policies, and should not stop the focus of industrial development at capital-intensive industrial sectors. Hao (2020) found that technology linkages have an important role in promoting innovation in labor-intensive industries. Li (2020) The minimum wage has a significant impact on innovation in labor-intensive firms. Chen Wei (2021) found that the impact of servitization of manufacturing on technological innovation in labor-intensive manufacturing was not significant.

### **2.2 Research on the relationship between financial development and technological innovation**

A well-developed financial system can be effective in mobilising savings (Levine, 1991[2]; Saint-Paul, 1992[3]; Bencivenga and Smith, 1991[4]), allocating resources (Greenwood and Jovanovic, 1990) [5], spreading risk, thus alleviating the financing dilemma of corporate innovation and promoting R&D and economic growth. Some literature emphasizes the driving role of banks, pointing out that banking competition (Dai, 2020[6]; Cai, 2016) is positively related to firm innovation, and scholars mostly draw on bank year-end deposit and loan data to argue the effect of the banking sector on innovation performance in terms of financial scale, financial efficiency and financial deepening. Other literature considers the role of the stock market, arguing that the stock market has a more significant role in promoting technological innovation due to its excellent risk reallocation function and reasonable pricing of assets, thus reducing information asymmetry (Zhong and Wang, 2017) [7]. Wei (2016) found a long-term stable cointegration relationship between financial development, technological innovation and industrial upgrading. Li (2022) found that the scale of finance and the degree of financial deepening had a significant role in promoting technological innovation.

The existing literature has examined the relationship between financial development, labor-intensive industries and their technological innovation, and financial development and technological innovation from different perspectives. However, from a comprehensive point of view, there are no uniform conclusions on the pros and cons of different financial development situations, and different countries and different industries have different requirements for innovation. This paper focuses on the basic characteristics of China's financial development and the situation of labor-intensive industries in China, and measures the level of financial development in terms of total financial volume and financial structure to explore the impact of financial development on technological innovation in labor-intensive industries.

## 3 Data and Model

### 3.1 Indicators

Explained variables. Patents are the most direct and measurable innovation output, so this paper uses patent data of labor-intensive industries as the explanatory variable.

Explanatory variables. In this paper, financial development is measured from two perspectives: financial aggregates and financial structure. (1) The first indicator of financial aggregates is the financial-related ratio (FIR), which uses the ratio of the sum of deposit and loan balances of financial institutions to GDP as an approximate measure of FIR, following the approach of Zhang (2013) [8]. The second indicator of financial aggregates is the level of development of digital inclusive finance. (2) The first indicator of financial structure is the concentration of banks, measured by the Herfindahl-Hirschman Index of the banking industry. The second indicator is the ratio of financing, borrowing from Liu (2017) [9], using the balance of various loans and total stock market transactions of financial institutions in each region to measure the level of development of credit market and the level of capital market development indicators, and using the ratio of the two as a measure of financial structure.

Control variables. The following four control variables were selected for this paper: degree of trade openness, urban per capita income, average value of total assets of labor-intensive enterprises, and number of labor-intensive enterprises in the province.

### 3.2 Model building

After F-test and Hausman-test, this paper chooses the fixed effect model. Fixed effects model is a panel data analysis method. It refers to the experimental design in which the experimental results only want to compare the specific category or difference between categories of each self-variable term and the specific category or interaction effect with other self-variable terms, without inferring to other categories or categories not included in the same self-variable term. To study the impact of financial development on technological innovation in labor-intensive industries, this paper controls the year - fixed effect and province - fixed effect, the specific model is shown in (1).

$$RI_{i,t} = \alpha_0 + \alpha_1 FIR + \alpha_2 FIR^2 + \alpha_3 DIG + \alpha_4 FS + \alpha_5 HHI + \alpha_6 Control + \sum YEAR + \sum PROVINCE + \varepsilon_{i,t} \quad (1)$$

Where model subscript  $i$  represents 30 regions in China,  $t$  represents 2011-2020,  $RI$  represents substantive technological innovation,  $FIR$  represents financial related ratio,  $DIG$  represents digital financial inclusion development level,  $FS$  represents financing ratio,  $HHI$  represents bank concentration.

### 3.3 Data description

The data in this paper covers the period from 2011 to 2020, and the following three types of data were selected for the study: (1) patent data: PatSnap's global patent database of listed companies; (2) enterprise information data: CSMAR database. The industry classification is based on the SFC Industry Classification Guidelines (revised in 2012), with the manufacturing industry adopting the secondary classification and the remaining industries adopting the primary classification. (3) Provincial data: CSMAR database, the third Digital Inclusive Finance Index

released by Peking University, statistical yearbooks of various provinces and regions, China Statistical Yearbook, etc.

## 4 Empirical analysis

### 4.1 Identification of labor-intensive industries

In this paper, industries will be classified through K-means cluster analysis. Drawing on the approach of Lu (2013) [10], a cluster analysis is conducted to classify labor-intensive industries according to their factor intensity. By using the SPSS software, Cluster analysis results show that, the following industries are labor-intensive industries: Culture, sport and entertainment, Real estate, Education, Residential services, repairs and other services, Wholesale and retail trade, Health and social work, Scientific research and technical services, Accommodation and catering, Rental and business services, Water, Environment and Public Facilities Management, Textile, clothing and apparel industry, Leather, fur, feather and feather products and footwear.

### 4.2 Empirical results

This paper uses stata16.0 software for analysis. The results are shown in Table 1.

**Table 1.** Impact of financial development on technological innovation in labor-intensive industries.

Variables	RI
FIR	1.1574*** (3.13)
FIR^2	-0.1338*** (-3.13)
DIG	0.8717** (2.35)
FS	0.0105* (1.69)
HHI	-12.8986*** (-3.00)
Year FE	YES
Province FE	YES
t-statistics in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 1 reports the full-sample estimation results of the impact of financial development on technological innovation in labor-intensive industries. The results show that: (1) from the perspective of total finance, the primary term coefficient of FIR is significantly positive at the 1% level and the secondary term is significantly negative at the 1% level, with an inverted U-shaped impact on technological innovation in labor-intensive industries; The level of digital inclusive financial development (DIG) has a positive impact on technological innovation in labor-intensive industries. (2) From the perspective of financial structure, the impact of financing structure (FS) on technological innovation in labor-intensive industries is significantly positive, indicating that indirect financing is more conducive to technological innovation in labor-intensive industries; the regression coefficient of bank concentration (HHI) on

technological innovation in labor-intensive industries is -12.8986 and is significant at the 1% level, indicating that bank concentration has a inhibiting effect on technological innovation in labor-intensive industries.

To further test the regional heterogeneity of the impact of financial development on technological innovation in labor-intensive industries, this paper will divide China into three regions, namely the eastern, central, and western regions, and the data regression results for each region are shown in Table 2.

**Table 2.** Analysis of heterogeneity: the impact of regional characteristics.

Variables	RI		
	East	Central	Western
FIR	2.0498*** (2.70)	0.8365 (0.97)	0.7327 (0.49)
FIR <sup>2</sup>	-0.2016** (-2.62)	-0.1468 (-1.22)	-0.0682 (-0.29)
DIG	0.4856 (0.61)	0.7123 (1.47)	0.6733 (0.83)
FS	0.0054 (0.21)	0.0052 (0.26)	-0.0106 (-0.98)
HHI	0.7304 (0.07)	-2.7446 (-0.49)	-5.3078*** (-5.48)
Year FE	YES	YES	YES
Province FE	YES	YES	YES

t-statistics in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The results show that in the eastern region, the inverted U-shaped impact of financial related ratio (FIR) on technological innovation in labor-intensive industries still holds. In the western region, the regression coefficient of bank concentration (HHI) on technological innovation in labor-intensive industries is -5.3078 and significant at the 1% level, indicating that bank concentration (HHI) has a significant negative effect on technological innovation in labor-intensive industries, i.e. bank concentration has an inhibitory effect on technological innovation in the western region.

## 5 Conclusions and Suggestions

Based on two-way fixed effects model, this paper analyses the impact of financial development on technological innovation in labor-intensive industries from the perspective of financial scale and financial structure. From the perspective of financial aggregates, the impact of financial-related ratios on technological innovation in labor-intensive industries is inverted U-shaped, and this finding holds for the full sample and the eastern region classification, indicating that when financial aggregates are small, they have an incentive effect on technological innovation in labor-intensive industries, and after financial aggregates exceed a certain limit, financial aggregates have a suppressive effect on technological innovation in labor-intensive industries. From the perspective of financial structure, indirect financing is more favourable to technological innovation in labor-intensive industries, and reducing bank concentration can directly and effectively enhance technological innovation in labor-intensive industries, and there

is regional heterogeneity in the effect of bank concentration, which mainly exists in the western region.

The following suggestions are made to improve the role of financial development in promoting technological innovation in labor-intensive industries: First, ensure the orderly expansion of financial scale. Governments at all levels in China should promote the orderly development of finance on the premise of ensuring a balanced match between the level of regional economic development and the expansion of financial scale, and should not blindly pursue the expansion of financial scale. Second, promote the high quality development of digital finance. In line with the rapid development of digital technology, we should support the integration of finance and technology, and give enough room for trial and error to develop high-quality digital finance while keeping the bottom line of risk. Third, improve the competition system in the banking sector. The scale structure of the banking industry should be optimised to ensure the survival and development of small and medium-sized banks and to build a multi-level banking system.

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